

LANSCE Materials Tests for Advanced Fuel Cycle Research

Energy Policy and Research Needs

The Administration concluded in the *National Energy Policy* document, that nuclear energy is the only technology available that can produce economic, base-load quantities of energy without emitting harmful pollutants associated with global climate change.

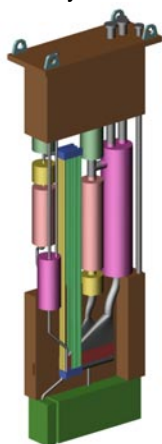
One of the main impediments to increased use of nuclear power is the concern for treatment and disposal of wastes. In DOE's January, 2003 report to congress, DOE established an Advanced Fuel Cycles Initiative (AFCI) to develop technologies to (1) reduce spent fuel volume, (2) separate long-lived, highly toxic elements and (3) reclaim spent fuel's valuable energy.

Admiral Rickover once stated that the difference between a real reactor and a reactor design is corrosion. For nuclear systems this means nuclear materials behavior. Unfortunately, the US has no broad-spectrum irradiation facilities for materials testing for advanced fuel cycle concepts.

Europe and Japan have concluded that accelerator research facilities should be built, and they are pursuing programs to support this effort. The US is ahead in this area by having the world class LANSCE facility at Los Alamos. By adding a target facility, the US could have a leading broad-spectrum irradiation tests facility. This could be accomplished for \$20M in three years. ***This is the low-cost fast-schedule option for the US.***

LANSCE Materials Test Station

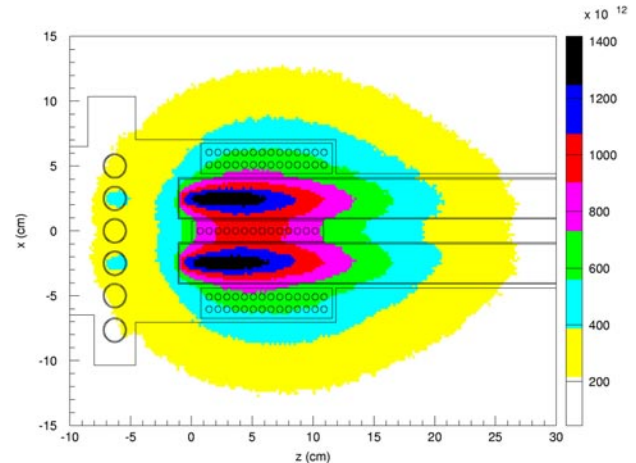
The concept being proposed is to build a new target in area A of the Los Alamos Neutron Science Center (LANSCE) accelerator facility.



The new target would utilize many existing elements of LANSCE, including the accelerator, beam transport, control systems, and target cooling systems. The new target would have a 15-foot diameter vacuum tank, vacuum system and shielding. Spallation targets would be

placed in the tank to generate spallation neutrons and contain experimental samples. Within the spallation target would be a number of irradiation test locations. One of the main advantages of using an accelerator-driven spallation neutron source is the intrinsic safety feature that shutting down the beam shuts down the system.

A split target is proposed to create a flux trap in the sample test volume between the two target halves. The flux distribution plot below shows this flux trap effect.



LANL Advanced Fuel Cycle Programs has looked at three evolutions of spallation targets for this application. The first target would be a water-cooled tungsten target that has a proven record as a spallation neutron source. Next to be deployed would be a liquid lead-bismuth spallation source that could operate at higher temperatures and investigate liquid metal environments. The third type of target proposed is uranium with 10% molybdenum. This target would yield prototypic fluxes of 1×10^{15} n/cm²/s.

The irradiation needs of the AFCI and Gen IV programs include high-temperature irradiation of structural/cladding materials in a fast reactor/spallation type spectrum. The irradiation temperature of interest for the AFCI program is 400-600C while that for the Gen IV materials program is 500-1000C. Irradiations should be performed up to doses of 200 displacements per atom. This would take up to 10 years in BOR-60, Phenix, or JOYO, assuming that these reactors and irradiation temperatures are available. Such doses could be achieved in FMTS in two-thirds that time.

Bottom Line

Irradiated materials testing, by its very nature, takes a long time to determine the aging properties of irradiated materials. Facilities in the US are not adequate to support advanced fuel cycle initiatives. A new Materials Test Station at LANSCE could be built for \$20M, in three years to provide a world-class irradiation facility.